this); one cannot help being on the lookout for that "favorable difference," independent of absolute color or brightness, which Neiglick has shown the existence of in brightness contrast.

C. L. F.

Ueber die Ursachen der Erythropsie. DOBROWOLSKY. Archiv für Ophthalmologie, Vol. 33, 2, p. 213.

After the performance of certain operations upon the eye, the patient sometimes sees everything violet, rose-colored or reddish, or in some cases of a bright red, even a blood-red, color. Occasionally darker objects look green. The affection lasts sometimes for a few minutes, sometimes for days; since its first accurate description in 1881, over thirty cases have been noted. Dobrowolsky has confirmed by experiment the hypothesis that it is due to an after-image of some bright object, as the edge of the sun or a bright cloud. He widened the pupil of one eye by atropin, and then found that after looking at a bright cloud near the sun, or the edge of the sun itself, all white objects in a room looked violet. This violet color lasted sometimes for a quarter of an hour, and it was succeeded by a state of excitation of the retina, during which, for an hour, all objects looked yellow, orange, or carmine-red. With the other eye, the pupil of which was kept narrow for purposes of comparison, a sharp, distinct after-image of the sun was obtained which was bright blue in the middle and violet on the edge. The widening of the pupil is then, under ordinary circumstances, a necessary condition for the production of the phenomenon. Violet-vision would be a better name for it than red-vision; it might be expected to occur more frequently were it not that the eyes are usually protected from a bright light when they are in a condition favorable to bringing it on.

(1) *Ueber die Zeit der Erkennung und Benennung von Schriftzeichen, Bildern und Farben.* JAMES MCKEEN CATTELL. Wundt's Philos. Studien, II (1885), pp. 635–650. Also in abstract by the author, Mind, XI (1886), pp. 63–65.

(2) *Ueber die Trägheit der Netzhaut und des Sehcentrums.* JAMES MCKEEN CATTELL. Wundt's Philos. Studien, III (1885), 1, pp. 94–127. Also, slightly abbreviated, Brain, Vol. VIII, pp. 295–312.

(3) *The Influence of the Intensity of the Stimulus on the Length of the Reaction Time.* JAMES MCKEEN CATTELL. Brain, Vol. VIII, p. 512.

(1) In the time measurements of which this study consists, complicated apparatus was avoided. For the first series, a kymograph drum was covered with white paper, on which the letters, pictures, or colored spots to be shown, were pasted. Between the drum and the subject was a screen, and in it a horizontal slit of adjustable length, through which the letters, etc., were to be viewed. The letters were so spaced that when the slit was 1 cm. long, the second letter was brought into view as the first disappeared; when the slit was 2 cm. long, two letters were constantly in the field, and so on. The following are the average times from nine subjects:

Length of slit in mm.........	1	2.5	5	10	20	30	40	50	60
Time in thousandths of a sec.,	499	356	292	248	225	209	202	198	198

From this it appears that about 0.25 s. was required for each letter when the slit was 10 mm. long and one letter at a time could be

seen. This, however, does not fully represent the time needed to recognize and name a letter, because the name of the first letter was being automatically pronounced at the time that the second letter was coming into recognition; the full process is about 0.1 s. longer. When the slit was still longer, the overlapping process was extended, and while the first was being recognized, several letters were going through the preliminary stages. Some subjects were assisted by having as many as five letters in the field at once. When the slit was shortened instead of lengthened, the times are longer; greater concentration of the attention was necessary, and the overlapping process did not take place so readily. Counting letters or dots took longer than naming the letters, but was shortened if they were grouped by twos, or better still, by threes.

In the second series the subjects read connected and unconnected letters and words, and the time for a fixed number was taken with a pocket chronometer. Reading as fast as possible, it took about twice as long to read unconnected words as connected ones, that is, about 0.25 s. per word, which is about the same as for *ordinary* reading of connected words. The reading of connected letters and words seems to be facilitated by an overlapping of processes like that in the first series. Disconnected letters were read a little faster than disconnected words, and Latin faster than German letters. The time per word for 100 connected words, read as rapidly as possible, was for Dr. Cattell himself: English 0.138 s., French 0.167, German 0.250, Italian 0.327, Latin 0.434, Greek 0.484, following the order of his familiarity with those languages. It took about twice as long to name colors and pictures as words and letters, the extra time seeming to be spent in hunting for their names, which in the case of letters and words come of themselves.

(2) With the inertia which continues sensation every one is familiar in the form of after-images, but that which hinders its beginning is not of common observation and has been little studied. It is the time required for the overcoming of this latter kind of inertia that the author has measured. The instrument used was the gravity chronometer, which is essentially a device for letting a screen with a horizontal slit in it, fall in front of the object that is to give the stimulus. Before and after the fall the object is hidden; it is seen while the slit passes over it. A slit 1.3 mm. wide corresponded in these experiments to 0.001 s. The objects were colored surfaces, letters, and German and English words. The illumination was lamplight or that of the clear sky. The colors were red (rather dark), orange, yellow, green, blue, and violet (slightly red). In showing these by means of the chronometer, a length of time was found at which each could be distinguished from a corresponding shade of gray, about nine times in ten. Seven subjects with sky illumination gave average times as follows, the unit being 0.001 s.: red 1.28, orange 0.82, yellow 0.96, green 1.42, blue 1.21, violet 2.32; the shortest of all being 0.6 for orange and yellow, and the longest, 2.75 for violet. When the first stimulus was followed immediately by a second (white, orange, and blue were tried), the times required for the first to produce its sensation were longer. With lamplight the times were also longer, and the order of quickness changed. The five grades of lamplight tried seem to justify the generalization that "the time colored light must work on the retina in order that it may be seen increases in arithmetrical progression as the intensity of

the light decreases in geometrical progression." The length of time for letters and words differs with the size and kind of type (Latin or German), and for words with their length. Letters and words in type of the size of the body of this magazine were read correctly half the time at from 0.001 s. to 0.0017 s. The time for words was in some cases even shorter than for letters. As before, the effect of an immediately following stimulus was to lengthen the time needed for seeing the letter or the word, but if it did not follow within 0.005 s. its effect was reduced. The times needed to see colors and letters represent not only the inertia of the retina, but also that of the brain; at least it may be supposed that stimuli acting on the retina for a less time do produce some effect, which, however, does not reach consciousness.

Some experiments were also made on the grasp of consciousness. Sets of from four to fifteen short perpendicular lines were shown for 0.01 s. Of the eight persons tried, two could give correctly the number seen up to six, two up to five, three up to four, and one not so many. Tried in this way, groups of letters are harder to grasp than groups of figures, because no combination of figures has a wholly strange look. A smaller number of words could be read than single letters; only half as many disconnected as connected words; and only one third as many disconnected letters as letters in words. In these experiments, especially in the last group, the individual differences of the subjects were considerable.

(3) Dr. Cattell's experiments extended only to variations in the intensity of light and induction shocks. Six grades of light were made by putting smoked glass before a Geissler tube, corresponding respectively to 315, 123, 23, 7 and 1 when the full light was counted as 1000. Two grades of higher intensity were made by putting lenses before the tube, but their relative intensity could not be fixed. On the basis of 150 reactions on each, reaction times were found varying for B. from 0.308 s. with the faintest light, to 0.168 s. with the brighest, and for C. from 0.251 s. to 0.128 s.; to these, however, the author does not attach an absolute accuracy, the important point being their relation. The decline took place with every increase of intensity, except once for B. Four grades of electrical stimulation were reacted to in times from 0.182 s. to 0.158 s. for B. and 0.164 s. to 0.131 s. for C., the decline being as before, including the exception of one for B., where perhaps the very violence of the stimulus caused a retardation of the reaction. On continuing the experiments to more complicated processes with grades of light corresponding to 315, 23, and 1, the experimenters found (giving the figures in the order of intensities from the greatest down) as follows:

Perception time, B. 0.049 s., 0.075 s., 0.100 s.; C. 0.085 s., 0.119 s., 0.114 s.

Will time, B. 0.049 s., 0.027 s., 0.020 s.; C. 0.082 s., 0.060 s., 0.078 s.

The Effect of Pure Alcohol on the Reaction Time, with a Description of a New Chronoscope. JOSEPH W. WARREN, M.D. Journal of Physiology, Vol. VIII, No. 6.

It must have been disappointing to the experimenter, as it certainly is to the reader, that this fully reported study should have led to such insignificant results. After more than eight thousand reaction-times taken, the conclusions are scarcely more than probabili-